CLAIMS

1. A method for making a projection screen, comprising:

depositing onto a diffusing substrate having a contour layers of high index-of-refraction (n) dielectric material and low n material so that the layers generally follow the contour of the diffusing substrate to provide a diffusing multilayer interference structure;

depositing, on another substrate, a polarizing coating to provide a polarizer for transmitting light with one linear polarization and for absorbing light with a second linear polarization;

applying, on at least one of the diffusing multilayer interference structure and a first surface of a matte diffuser, a first layer of uncured adhesive;

curing the first layer of uncured adhesive to provide a first layer of cured adhesive;

applying, on a second surface of the matte diffuser, a second layer of uncured adhesive;

curing the second layer of uncured adhesive to provide a second layer of cured adhesive; and

laminating the diffusing multilayer interference structure, the matte diffuser, the polarizer, and a front diffuser, the front diffuser characterized by a diffusion pattern in which lobes are non-perpendicular to the front diffuser.

2. A method for making a projection screen in accordance with claim 1, wherein the depositing the alternating layers further comprises,

prior to depositing the alternating layers of high n and low n dielectric material, depositing onto the diffusing substrate a first reflective layer, and

subsequent to the depositing the alternating layers of high n and low n dielectric material, depositing onto the alternating layers a second reflective layer.

3. An optical device, comprising:

a first reflective layer;

a second reflective layer;

substantially continuous layers of dielectric material, each layer consisting essentially of a material having a different index-of-refraction (n) than the material of an

adjacent layer, the layers disposed between the first reflective layer and the second reflective layer, constructed and arranged so that an optical output of the optical device includes substantially more light with wavelengths in a plurality of narrow wavelength bands than light with wavelengths not in the plurality of wavelength bands.

4. An optical device in accordance with claim 3, wherein the first reflective layer is highly reflective so that the optical output is reflected light with wavelengths in the plurality of narrow wavelength bands.

5. An optical device in accordance with claim 4, wherein the first reflective layer comprises aluminum.

6. An optical device in accordance with claim 3, wherein the first reflective layer is partially reflective so that the optical output comprises transmitted light with wavelengths in the plurality of narrow wavelength bands.

7. An optical device in accordance with claim 3, wherein the first reflective layer comprises a substrate comprising a reflective material.

8. An optical device in accordance with claim 7, wherein the first reflective layer comprises a diffuser.

9. An optical device in accordance with claim 8, wherein the first reflective layer comprises aluminum.

10. An optical device in accordance with claim 3, wherein the first reflective layer comprises a diffuser.

11. An optical device in accordance with claim 3, wherein the device has a width, height, and thickness and wherein the width and the height are greater than seven inches.

12. A diffusing optical device, comprising:

a light diffusing substrate with an irregular surface;

layers of dielectric material disposed on the substrate, the layers generally following a contour of the irregular surface of the diffusing substrate so that the surfaces of the layers are irregular.

13. An optical device in accordance with claim 12, each layer consisting essentially of a material having a different index-of-refraction (n) than the material of an adjacent layer, constructed and arranged so that the reflectance of light with a wavelength in a narrow wavelength band is significantly greater than the reflectance of light with wavelengths not in the wavelength band.

14. An optical device in accordance with claim 13, further comprising a first reflective layer and a second reflective layer, positioned so that the layers of dielectric material are between the first reflecting layer and the second reflecting layer and so that the first reflecting layer is between the dielectric layers and the substrate and wherein the first reflective layer and the second reflective layer follow the contour of the irregular surface of the diffusing substrate so that the surfaces of the reflective layers are irregular.

15. An optical device in accordance with claim 12, wherein the diffusing substrate is reflective.

16. An optical device in accordance with claim 15, further comprising a reflective layer, disposed on the layers of dielectric material so that the surface of the reflective layer is irregular.

17. An optical device in accordance with claim 12, wherein the surface of the substrate has irregularities with amplitudes in the range of 1 – 5 micrometers and periods in the range of 10 – 50 micrometers.

18. An optical device in accordance with claim 12, wherein the layers are constructed and arranged so that the reflectance of light with wavelengths in a plurality of wavelength bands is significantly greater than the reflectance of light with wavelengths not in the plurality of the wavelength bands

19. An optical device, comprising;

a first irregular, diffusing, reflective surface;

a second reflective surface, separated from the irregular diffusing surface by a gap wherein the irregular diffusing reflective surface, the second reflective surface, and the gap are constructed and arranged so that the reflectance of light with wavelengths in a

narrow of wavelength band is significantly greater than the reflectance of light with wavelengths not in the wavelength band.

20. An optical device in accordance with claim 19, further comprising:

layers of dielectric material, each layer consisting essentially of a material having a different index-of-refraction (n) than the material of an adjacent layer, the layers generally following a contour of the irregular surface of the diffusing substrate so that the surfaces of the layers are irregular, wherein the irregular diffusing reflective surface, the second reflective surface, and the layers of dielectric material are constructed and arranged so that the reflectance of light with wavelengths in a narrow wavelength band is significantly greater than the reflectance of light with wavelengths not in the wavelength band.

21. An optical device in accordance with claim 19, wherein the irregular diffusing reflecting surface is the surface of a metal substrate.

22. An optical device in accordance with claim 21, wherein the metal substrate comprises aluminum.

23. An optical device in accordance with claim 19, wherein the irregular diffusing reflecting substrate comprises a thin reflective coating.

24. A projection system, comprising:

a multi-layer projection screen, comprising,

a polarizing coating in the range of 1 to 10 micrometers thick, deposited on a substrate, constructed and arranged to selectively absorb light of one polarization and to transmit light of other polarizations.

25. A projection system in accordance with claim 24, further comprising a projector that is constructed and arranged to polarize light with wavelengths in a plurality of narrow wavelength bands into the one polarization.

26. A projection system in accordance with claim 25, wherein the projection screen further comprises layers of dielectric material, each layer consisting essentially of a material having a different index-of-refraction (n) than the material of an adjacent layer, deposited on a substrate, wherein the layers dielectric material are constructed and

arranged so that the reflectance of light with wavelengths in the plurality of narrow wavelength bands is substantially greater than the reflectance of light with wavelengths not in the plurality of wavelength bands.

27. A projection system in accordance with claim 26, wherein the substrate is a diffusing substrate.

28. A projection system in accordance with claim 26, where in the projection screen further comprises a first reflective layer and a second reflective layer, wherein the layers of dielectric material are positioned between the first reflective layer and the second reflective layer and wherein the first and second reflective layer and the layers of dielectric material are constructed and arranged so that the reflectance of light with wavelengths plurality of pre-determined narrow non-harmonic wavelength bands is substantially greater than the reflectance of light with wavelengths not in the plurality of wavelength bands and so that light with wavelengths not in the plurality of wavelength bands destructively interferes

29. A projection system in accordance with claim 26, wherein the dielectric layers are further constructed and arranged to transmit the light with wavelengths not in the plurality of wavelength bands, and wherein the projection screen further comprises an absorbing layer for absorbing light with wavelengths not in the plurality of wavelength bands.

30. A projection screen in accordance with claim 25, wherein the first polarization and the second polarization are linear polarizations.

31. A projection screen constructed and arranged so that the reflectance of light with wavelengths in a plurality of pre-determined narrow non-harmonic wavelength bands is substantially greater than the reflectance of light with wavelengths not in the plurality of wavelength bands, the projection screen comprising a selective reflecting device, the selective reflecting device comprising:

a substrate; and

a stack of consecutive layers of dielectric material, each layer consisting essentially of a material having a different index-of-refraction (n) than the material of an adjacent layer, the layers disposed on the substrate, constructed and arranged so that the

reflectance of light with wavelengths plurality of narrow non-harmonic wavelength bands is substantially greater than the reflectance of light with wavelengths not in the plurality of wavelength bands.

32. A projection screen in accordance with claim 31, further comprising a polarizer, for transmitting light with wavelengths that is polarized in one polarization and for absorbing light that is not polarized in the one polarization.

33. A projection screen in accordance with claim 31, wherein the layers are constructed and arranged to transmit light that is not reflected, the projection screen further comprising an absorbing layer to absorb the light that is transmitted.

34. A projection screen in accordance with claim 31, the selective reflecting device further comprising a first reflective layer and a second reflective layer, wherein the layers of dielectric material are disposed between the first reflective layer and the second reflective layer and wherein the selective reflecting device is constructed and arranged to cause the light with wavelengths outside the plurality of narrow wavelength bands to destructively interfere.

35. A projection screen in accordance with claim 34, further comprising a polarizer, for transmitting light with wavelengths that is polarized in one polarization and that is within the narrow wavelength bands and to absorb light with wavelengths that is not within the narrow wavelength bands.

36. A projection screen in accordance with claim 34, further comprising a front diffuser, wherein the front diffuser is constructed and arranged to diffuse asymmetrically in the X and Y directions.

37. A projection screen in accordance with claim 36, further comprising a polarizer, for transmitting light with wavelengths that is polarized in one polarization and for absorbing light that is not polarized in the one polarization.

38. A projection screen in accordance with claim 31, further comprising a polarizer constructed and arranged to transmit light of one polarization and to absorb light of other polarizations.

39. A projection screen in accordance with claim 38, further comprising a front diffuser, wherein the front diffuser is constructed and arranged to diffuse asymmetrically in the X and Y directions.

40. A projection screen in accordance with claim 38, wherein the screen is substantially planar and further comprising an optical device constructed and arranged to cause the projection screen to have a light reflection pattern that is characterized by a lobe with an axis that is not perpendicular to the plane of the projection screen.

41. A projection screen in accordance with claim 31, further comprising a front diffuser, wherein the front diffuser is constructed and arranged to diffuse asymmetrically in the X and Y directions.

42. A projection screen in accordance with claim 31, wherein the screen is substantially planar and further comprising an optical device constructed and arranged to cause the projection screen to have a light reflection pattern that is characterized by a lobe with an axis that is not perpendicular to the plane of the projection screen.

43. A projection screen in accordance with claim 42, wherein the optical device is constructed and arranged to cause the projection screen to have a light reflection pattern that is characterized by two lobes.

44. A projection screen in accordance with claim 42, wherein the optical device is constructed and arranged to cause the projection screen to have a light reflection pattern that has a lobe that has an axis that is slanted one of the directions of up, down, left, and right relative to the plane of the screen.

45. A multi-layer projection screen, comprising:

a selective reflecting device for selectively reflecting light so that the reflectance of light with wavelengths in a pre-determined non-harmonic plurality of wavelength bands is substantially greater than light with wavelengths not in the pre-determined non-harmonic plurality of wavelength bands; and

a matte surfaced diffuser for diffusing the light with the wavelengths in the pre-determined plurality of wavelength bands.

46 A projection screen in accordance with claim 45, wherein the matte surfaced diffuser comprises a substrate and a matte surfaced diffusing coating.

47. A projection screen in accordance with claim 45, wherein the matte surfaced diffuser is positioned between the selective reflecting device and a polarizer.

48. A projection screen in accordance with claim 45 wherein the matte surfaced diffuser is a substrate for a selective reflecting device comprising layers of dielectric material, each layer consisting essentially of a material having a different index-of-refraction (n) than the material of an adjacent layer,.

49. A projection screen in accordance with claim 48, wherein the matte surfaced diffuser is a substrate for the dielectric layers and wherein the projection screen further comprises

a first reflecting layer disposed on another substrate, wherein the dielectric layers are disposed on the first reflecting layer; and

a second reflecting layer disposed on the dielectric layers.

50. A method for manufacturing a multi-layer projection screen, comprising:

applying uncured adhesive to a first layer of the projection screen;

curing the adhesive; and

laminating a second layer of the projection screen to the first layer.

51. A method for manufacturing a projection screen in accordance with claim 50, wherein the applying the uncured adhesive to the one layer comprises applying the adhesive to a selective reflector, the selective reflector constructed and arranged so that the reflectance of light with wavelengths in a plurality of narrow wavelength bands is significantly greater than the reflectance of light with wavelengths not in the plurality of narrow wavelength bands.

52. A method for manufacturing a projection screen in accordance with claim 51, wherein the applying the uncured adhesive to the selective reflector comprises applying the uncured adhesive to a multilayer interference filter.

53. A method for manufacturing a projection screen in accordance with claim 51, wherein the applying the uncured adhesive to the selective reflector comprises applying the uncured adhesive to an etalon device.

54. A method for manufacturing a projection screen in accordance with claim 51, wherein the laminating the second layer comprises laminating a polarizer.

55. A method for manufacturing a projection screen in accordance with claim 54, wherein the applying the second layer comprises depositing a polarizing coating on a substrate.

56. A method for manufacturing a projection screen in accordance with claim 50, further comprising:

applying a second layer of uncured adhesive to the second layer of the projection screen; and

curing the second layer of adhesive.

57. A substantially planar projection screen comprising an optical device constructed and arranged to cause the projection screen to have a light reflectance pattern that is characterized by a lobe with an axis that is not perpendicular to the plane of the projection screen.

58. A projection screen in accordance with claim 57, wherein the optical device is constructed and arranged to cause the projection screen to have a light reflectance pattern that is characterized by two lobes.

59. A projection screen in accordance with claim 57, wherein the optical device is constructed and arranged to cause the projection screen to have a light reflectance pattern that has a lobe that has an axis that is slanted in one the directions up, down, left, and right relative to the plane of the screen.

60. A projection screen constructed and arranged to receive input light at a location on the screen, the input light being received at an angle relative to a surface of the screen at the location, the projection screen further constructed and arranged to reflect light from the location along an array of output directions that are distributed about an

output axis, the output axis being at an angle relative to the surface that is different from the angle than would have resulted if the surface were a simple plane reflector.

61. A projection screen in accordance with claim 60, wherein the input angle is normal and the output angle is other than normal.

62. A projection screen in accordance with claim 60, wherein the input angle is non-normal and the output angle is normal.

63. A method for making projection screen, comprising:

depositing onto a first substrate layers of dielectric material, each layer consisting essentially of a material having a different index-of-refraction (n) than the material of an adjacent layer;

depositing onto the layers of dielectric material a first reflective layer.

64. A method for making a projection screen in accordance with claim 63, further comprising the step of:

prior to the depositing onto the first substrate the layers of dielectric material, depositing onto the first substrate a second reflective layer, wherein the depositing onto the first substrate comprises depositing onto the second reflective layer the layers of dielectric material.

65. A method for making a projection screen in accordance with claim 63, wherein the depositing onto the first substrate layers dielectric material comprises depositing the layers of dielectric material onto a substrate with a reflective surface.

66. A method for making a projection screen in accordance with claim 63, wherein the depositing onto the first substrate layers of dielectic material comprises depositing the layers onto a diffusing substrate.

67. A method for making a projection screen in accordance with claim 66, further comprising the step of:

prior to the depositing onto the first substrate the layers dielectric material, depositing onto the substrate a second reflective layer, wherein the depositing onto the first substrate comprises depositing onto the second reflective layer the layers of dielectric material.

68. A method for making a projection screen in accordance with claim 67, wherein the depositing onto the first substrate layers of dielectric material comprises depositing the layers onto a substrate with a reflective surface.

69. A method for making a projection screen in accordance with claim 68, wherein the laminating step comprises

applying an adhesive in an uncured state to the diffusing layer; and

curing the adhesive.

70. A method for making a projection screen in accordance with claim 63, wherein the laminating step comprises

applying an adhesive in an uncured state to the diffusing layer; and

curing the adhesive.

71. A method for making a projection screen in accordance with claim 63, further comprising;

depositing onto one surface of a second substrate a polarizing layer;

depositing onto another surface of the second substrate a diffusing layer; and

laminating the polarizing layer to the reflective layer

72. A method comprising

at a projection screen receiving projected light and ambient light, processing the light, and preferentially reflecting portions of the light that are within at least two narrow spectral bands relative to reflection of light that is not within the narrow spectral bands,

the processing occurring within consecutive layers of higher and lower index-of-refraction materials.

73. A method in accordance with claim 72, wherein the processing the light comprises reflecting the light, by a first and second reflective layer constructed and arranged so that the consecutive layers of higher and lower index of refraction materials are between the first and the second reflected layer, so that light with wavelengths not in the plurality of narrow bands of wavelengths destructively interferes.

74. A method in accordance with claim 72, further comprising polarizing, by a projector, so that the projected light has substantially more light of one linear polarization than of another linear polarization and

polarizing, by the screen, of the projected light and the ambient light so that the screen reflects substantially more of the light of the one linear polarization and absorbs light of the second linear polarization.

75. A method in accordance with claim 72, further comprising projecting the light by a projector that is constructed and arranged to project substantially more light with wavelengths in the plurality of narrow bands of wavelengths than light with wavelengths not in the plurality of narrow bands.